ARTICLE XVII.

Observations to determine the horizontal Magnetic Intensity and Dip at Louisville, Kentucky, and at Cincinnati, Ohio. By John Locke, M. D., Professor of Chemistry in the Medical College of Ohio. Read May 15, 1840.

THE following observations were made to determine the relative horizontal magnetic intensities at Louisville, Kentucky, and Cincinnati, Ohio. The apparatus used was that invented by Professor Bache, in which the needles are made to oscillate in a rarefied medium. Two of the needles used (Nos. 1 and 2) were of the model of those of Professor Hansteen; the third (No. 3) was flat, with lozenge points.

HORIZONTAL INTENSITY.

No. of Needle.	Time of Commencement.	Mean Temp.	Duration of 500 Vibrations.	Calculated duration at 60°.	Square of the Time.	Observations.
Cincinnati, March 7, 1840. Latitude 39° 06′ N.; Longitude 84° 27′ W.
No. 1	11ʰ 10ᵐ 05ˢ.6	56° 64′ F.	25.6666 Min.	25.6777 Min.	659.34428	Cloudy; sprinkles of rain.
2	11 47 04.4	58 00	25.3733	25.3808	644.18500	do. do. do.
3	12 36 05.6	60 00	20.6160	20.6160	425.01945	do. do. do.
Cincinnati, March 14, 1840.
No. 1	11ʰ 33ᵐ 59ˢ.2	48° 5′ F.	25.6600 Min.	25.6954 Min.	660.25358	Beginning to rain.
2	12 16 03.2	45 0	25.3600	25.4151	645.92731	Raining.
3	12 54 59.2	45 5	20.6066	20.6239	425.34525	do.
Louisville, Ky., March 10, 1840. Latitude 38° 03′ N.; Longitude 85° 30′ W.
No. 1	11ʰ 44ᵐ 0.2ˢ4	59° 50′ F.	25.3333 Min.	25.3363 Min.	641.77777	Clear; brisk N. W. wind.
2	12 20 58.8	57 50	25.0200	25.0290	626.45084	do. do. do.
3	1 18 00.0	57 10	20.3333	20.3368	413.58540	do. do. do.
Louisville, March 11, 1840.
No. 1	11ʰ 40ᵐ 04ˢ.8	39° 5′ F.	25.3000 Min.	25.3622 Min.	643.24119	Clear; wind moderate.
2	12 14 04	41 0	24.9733	25.0421	627.10677	do. do. do.
3	12 48 03.2	43	20.3200	20.3400	413.71560	do. do. do.

By comparing these double suites of experiments made at each of the places, Cincinnati and Louisville, I obtain the following ratios of horizontal intensity:

Cincinnati, March 7th, and Louisville, March 10th, 1840.

		Lou.	Cin.
By needle No. 1,	. . . .	1:	0.9733
" No. 2,	. . . .	1:	0.9723
" No. 3,	. . . .	1:	0.9730

Cincinnati, March 7th, and Louisville, March 11th.

By needle No. 1,	. . . .	1:	0.9755
" No. 2,	. . . .	1:	0.9735
" No. 3,	. . . .	1:	0.9734

Cincinnati, March 14th, and Louisville, March 10th.

By needle No. 1,	. . . .	1:	0.9720
" No. 2,	. . . .	1:	0.9698
" No. 3,	. . . .	1:	0.9723

Cincinnati, March 14th, and Louisville, March 11th.

By needle No. 1,	. . . .	1:	0.9742
" No. 2,	. . . .	1:	0.9709
" No. 3,	. . . .	1:	0.9726
Mean,	. . . . .	1:	0.9727

We have, then, the horizontal intensity at Louisville to that at Cincinnati as 1 to 0.9727.

MAGNETIC DIP.

Cincinnati, March 6th, 1840, 2 h. 30 m., P. M.   Longworth's Garden.

By needle No. 1,	. . . .	70° 27'.25
" No. 2,	. . . .	70 27 .8125
Mean,	. . . . .	70 27 .5312

Cincinnati, March, 3h. 30m., P. M., at my own house, in the garden.

By needle No. 1, ...   70° 24'.25
"   No. 2, ...   70 22 .8125
                                                        _____
                          Mean, ...   70 23 .5312

Mean dip at Cincinnati, 70° 25'.5312*

Louisville, March 10, 8h. 13m., A. M.   Jacob's Woods.

By needle No. 1, ...   69° 55'.25
"   No. 2, ...   69 51 .375
                                                        _____
                          Mean, ...   69 53 .3125

Louisville, March 11, 6h. 23m., A. M.   Jacob's Woods.

By needle No. 1, ...   69° 57'
"   No. 2, ...   69 56 .75
                                                        _____
                          Mean, ...   69 56 .875

Louisville, March 11th, 5h. 27m., P. M.

By needle No. 1, ...   69° 55'.125
"   No. 2, ...   ·69 53 .75
                                                        _____
                          Mean, ...   69 54. 4375

Mean dip at Louisville, 69° 54'.8750.

The relative total intensities at Louisville and Cincinnati, calculated from the preceding elements of dip and horizontal intensity at the same places, are as 1.0000 : 1.0031.

The following experiments were made to determine the correction for temperature of these needles.

A stove and pipe of copper were introduced into a room in my house, fifteen feet square, and having no unusual quantity of iron about it. Opening the room on the morning of the 22d of March, the apparatus was cooled down to 38° F., and the time of five hundred vibrations observed. It was then heated as rapidly as possible by means of the copper stove to 91°.4, and the time of five hundred vibrations again observed and noted. The constant coefficient

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* The dip determined at Longworth's garden since this period, namely, 21st of April, 1840,
    was, by Needle No. 1, ... 70° 29'.68
          "   No. 2, ... 70 28
                                                                  _____
                          Mean, ... 70 28 .84

was then deduced by Hansteen's formula. Similar experiments were made with the other needles, as below.

			Min.	Sec.
March 22d, 1840. Needle No. 1. Temperature 38°. 500 vibrations in			25	34.8
Temperature 91.4. " "			25	44.8
Coefficient deduced,			0.000117	
March 25. Mean temperature 37° 36'. Needle No. 1. 500 vibrations in			25	33.8
Mean temperature 91 5 " " " "			25	44
Coefficient deduced,			0.000122	
Mean for No. 1,			0.000125	
March 24. Mean temperature 50. Needle No. 2. 500 vibrations in			25	18.8
86.12 " " " "			25	26.8
Coefficient deduced,			0.000145	
March 25. Mean Temperature 48. Needle No 3. 500 vibrations in			20	34.6
90 " " " "			20	37.6
Coefficient deduced,			0.000058	

This last needle, the flat one with lozenge points before referred to, seems very little affected by temperature.

It may, perhaps, excite surprise, and, possibly, some doubt as to the accuracy of my observations, that the dip given above for Cincinnati is so much less than that which I obtained in November, 1837, the latter being 70° 45'.75, and the former 70° 25'.5312; and that the dip at Louisville, August 31, 1839, should have been 70° 08', and on March 11, 1840, only 69° 54'.4375, or, as a mean, 69° 54'.8750. It is probable, from an experiment recorded in Major Long's expedition, making the dip at St. Louis, in 1819, 70° 30', and, by my own observations, in 1839, making it, at the same place, only 69° 31'.4, the interval being twenty years, that the dip at this part of the earth is diminishing at the rate of about 3' per annum. This will account for part of the change observed at Cincinnati. The remainder is probably produced by the seasons, which Hansteen allows to have an influence to the extent of 15'. Allowing 7' for the annual diminution of the dip since November, 1837, we have for the change produced by the seasons,

$$70° 25'.5312 + 7' + x = 70° 45'.75, \text{ and}$$
$$x = 70° 45'.75 - 70° 25'.5312 - 7' \text{ or}$$
$$x = 13' 288 = \text{the above named change.}$$